

### REMARKS

The Examiner rejected claims 1, 2, 4, 5, 7, and 8 under 35 U.S.C. 102(e) as being anticipated by Ibbetson, *et al* (hereafter "Ibbetson") (6,515,313). The above amendments cancel Claims 1, 2, 7, and 8, and hence, render this rejection moot with respect to these claims. Applicant traverses the rejection of Claims 4 and 5.

Regarding Claim 4, the Examiner stated that Ibbetson teaches that the GaN base layer might have a wurtzite structure which has a c-axis ([0001] orientation). The Examiner goes on to state that the limitation of a reverse axis is non-limiting due to the fact that any axis has both a forward and a reverse orientation. Applicant must respectfully disagree. Ibbetson teaches that the base layer is grown on the normal c-axis. As pointed out in the specification, such a substrate has the Ga- face exposed. A reverse c-axis is defined in the specification as a GaN substrate in which the nitrogen-face is exposed. Since Ibbetson teaches a substrate in which the Ga-face is exposed, Claim 4 and Claim 5, which depends therefrom, could not be anticipated by Ibbetson. The amendment to Claim 4 places that claim in independent form.

The Examiner rejected Claim 3 under 35 U.S.C. 103(a) as being unpatentable over Ibbetson in view of Holonyak, Jr. (US Patent 6,369,403). Applicant traverses this rejection.

The Examiner admits that Ibbetson does not teach a reverse biased tunnel diode. The Examiner looks to Holonyak as teaching a reverse biased tunnel diode. According to the Examiner, it would have been obvious to one of ordinary skill in the art at the time of the invention to include a tunnel junction in Ibbetson as taught by Holonyak to facilitate the transferring of electrons through the diode for more efficient output. First, the inclusion of the reversed biased tunnel diode does not facilitate the transferring of electrons through the active region. If anything, a reversed-biased tunnel junction reduces the flow of carriers compared to arrangements without such a reverse-biased diode. Hence, the Examiner's motivation for combining the teachings of the references is flawed, since the claimed result would not be obtained.

Second, Holonyak teaches a tunnel junction that is placed above the active region in a diode in which the n-type material is on the substrate. The purpose of the layer is to allow the

p-type contact layer in conventional VCSELs to be replaced by an n-type contact layer that has lower resistivity, and hence, is better adapted to spreading the current from the top electrode. Thus, the combination of the teachings of Ibbetson and Holonyak would be a laser with the tunnel diode junction above the active region. That is not the present invention as claimed in Claim 3. To further emphasize this difference, Claim 3 has been amended to explicitly require the tunnel junction to be between the active layer and the substrate.

The Examiner rejected Claims 6 and 11 under 35 U.S.C. 103(a) as being unpatentable over Ibbetson in view of Anayama, *et al* (hereafter "Anayama") (US Patent 5,799,027). Applicant traverses this rejection.

The Examiner admits that Ibbetson does not teach an angled active layer. The Examiner looks to Figure 1 of Anayama as teaching a semiconductor device comprising an angled substrate. According to the Examiner, it would have been obvious to one of ordinary skill in the art at the time of the invention to use an angled active layer in Ibbetson as taught by Anayama to confine light in both the perpendicular and lateral directions.

Claims 6 and 11 require that said substrate has a planar surface on which said layers are grown and that said active layer is grown on a surface that is tilted at an angle with respect to said substrate. As noted by the Examiner, the substrate shown in Figure 1 of the reference is not a planar surface, but rather a surface having a number of planar facets at angles to one another. The active layer likewise has a faceted structure and is grown on a surface that is parallel to this substrate surface. Hence, the layers taught in Anayama do not satisfy the limitations of Claims 6 and 11. Accordingly, Applicant submits that there are additional grounds for allowing Claims 6 and 11. The above amendments to Claims 6 and 11 place these claims in independent form.

The Examiner rejected Claims 9 and 10 under 35 U.S.C. 103(a) as being unpatentable over Ibbetson in view of Smith, *et al* (hereafter "Smith") ("Determination of wurtzite GaN...") and Tsuda, *et al* (hereafter "Tsuda") (US Patent 6,294,440). Applicant traverses this rejection.

In making this rejection, the Examiner stated that Ibbetson teaches in column 2, lines 1-15 crystal layers grown along the 0001 orientation, such as wurtzite GaN crystals, but does not teach the specific growing method of said GaN base layer. According to the Examiner, Smith teaches in the abstract the properties of the Ga- side of the crystal and N side of the crystal. Applicant must point out that Smith does not teach that one side or the other is superior for growing subsequent semiconductor layers. The Examiner goes on to point out that Tsuda teaches growing a GaN layer on a substrate, removing the substrate, and then using the GaN layer as a base layer. It must be pointed out that Tsuda teaches growing subsequent layers on the side of the substrate opposite to the side that was in contact with the original substrate on which the GaN layer was grown. Hence, the combination of the teachings of Ibbetson and Tsuda would be a method in which layers are deposited on a GaN substrate that was removed from a sapphire substrate without turning over the GaN substrate as required by the Claim 9.

The Examiner attempts to overcome this problem by characterizing the choice of sides used to grow the subsequent layers as merely determining the optimum side of the crystal. Applicant must point out that the Examiner has not pointed to any teaching that one side is optimum for growing semiconductor layers. Smith merely teaches that the sides are not equivalent. Accordingly, there is no motivation for altering the teachings of Tsuda to arrive at the present invention as claimed in Claim 9. "The mere fact that a reference could be modified to produce the patented invention would not make the modification obvious unless it is suggested by the prior art." (*Libbey-Owens-Ford v. BOC Group*, 4 USPQ 2d 1097, 1103). Hence, Applicants respectfully submit that the Examiner has not made a *prima facie* case for obviousness with respect to Claim 9 or Claim 10, which depends therefrom.

Regarding Claim 10, the Examiner argues that Ibbetson teaches MBE to form layers. The issue is not whether it is known to use MBE to form layers but rather which layers are to be formed in that manner. Accordingly, there are additional grounds for allowing Claim 10.

I hereby certify that this paper is being sent by FAX to 703-872-9318.

Respectfully Submitted,



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